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The Journal

of the

AMERICAN LEATHER CHEMISTS ASSOCIATION

Vol. LIV DECEMBER 1959 No. 12

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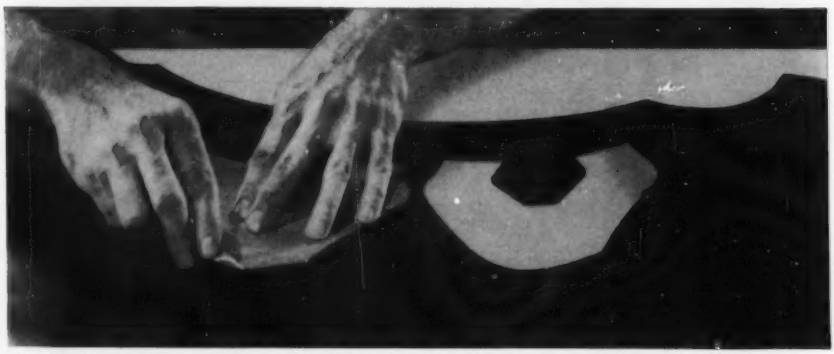

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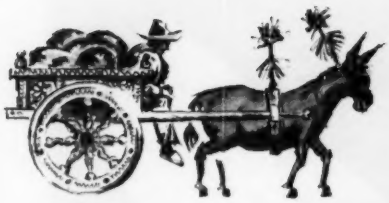

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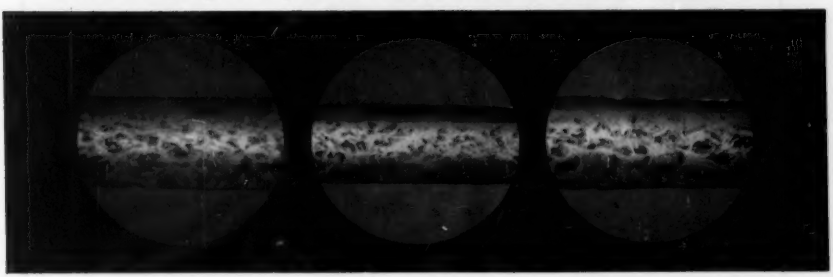

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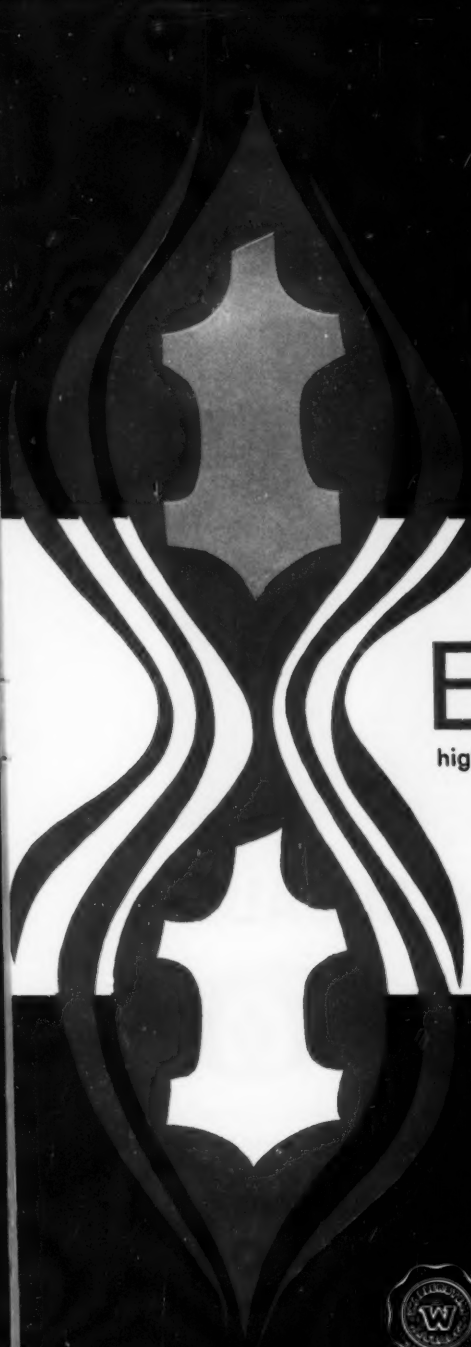

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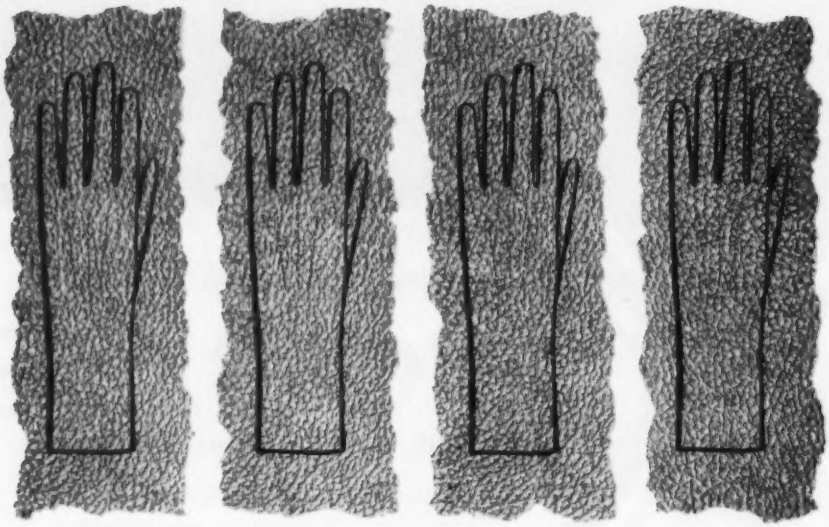

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TANNING WITH GLUTARALDEHYDE

II. PROPERTIES OF THE LEATHERS*

E. M. Filachione, M. L. Fein, E. H. Harris, F. P. Luvisi, A. H. Korn, W. Windus, and J. Naghski

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Philadelphia 18, Pennsylvania

ABSTRACT

Sheepskins were tanned with glutaraldehyde under various conditions. The tanned skins were processed with regular packs into finished garment leather in a commercial tannery. Leather judged to be quite satisfactory was obtained under a wide variety of tanning conditions. The leathers showed unusual resistance to deterioration by a synthetic perspiration and by hot soap solutions, in contrast to formaldehyde and glyoxal leathers.

—×—×—

INTRODUCTION

The preceding paper (1) reported a study of the tanning properties of glutaraldehyde, a newly available dialdehyde. This aldehyde appeared to be unusually reactive toward hide substance and exhibited tanning properties of value from a practical standpoint. It effects tanning over a wide pH range. The tannage is rapid and may be accomplished within a few hours with as little as 1.5% of active aldehyde on the drained pickled skin basis. To evaluate this tannage fully it was important to examine the properties of the leathers produced with glutaraldehyde. Of particular interest was a comparison of this leather with that obtained with formaldehyde. In the present study, full sheepskins were tanned with the desired aldehyde in the laboratory and then processed into finished leather in a commercial tannery with regular packs of garment leather. The results are reported in this paper.

*Presented at the Fifty-fifth Annual Meeting of American Leather Chemists Association, Mackinac Island, Michigan, June 14–17, 1959.

†Eastern Utilization Research and Development Division, Agricultural Research Service, United States Department of Agriculture.

EXPERIMENTAL

Twenty-Four-Hour Tannages

Pickled, degreased Syrian sheepskins obtained from a garment leather tannery were tanned with glutaraldehyde for 24 hours under various conditions as described in the preceding study (1). The identical skins obtained at the end of the 24 hours of tanning in the rate studies were used. The tanned skins were washed briefly in running water; acidified, if necessary, with dilute acetic acid to pH of about 5; and processed into finished leather with regular packs at a garment leather tannery.

For purposes of comparison, Syrian sheepskins were also tanned with formaldehyde at pH values of approximately 4.8, 8.0, and 9.4 and with glyoxal at pH 8.1 as described previously (1). These tannages were carried out exactly as was done for the glutaraldehyde except for replacing the 12% glutaraldehyde (25% solution) with an equivalent amount of formaldehyde or glyoxal. The leathers were finished in the same manner as those above.

The various tannages are summarized in Table I.

Evaluation of the leather.—Chemical analyses, strength properties, perspiration resistance, and washability tests were carried out on the finished leathers. The test pieces were taken from the same skin location, which was essentially equivalent to Test Area "W" described in *Sampling Light Leather for Physical Tests* (2).

Perspiration resistance—Samples cut from the finished leathers were tested for perspiration resistance by a slight modification of the procedure described by Colin-Russ (3). Briefly, small pieces of leather were soaked about 2 hours in a synthetic perspiration solution made up of urea, sodium lactate, disodium phosphate, sodium chloride, and water. Acid or alkali was added if necessary to bring the pH to 7.0–7.1. The saturated pieces of leather were held over water in a closed vessel at 70°C. for 48 hours. After air-drying, the dimensions of the samples were measured and percentage area shrinkage calculated. Results are summarized in Table II.

Washability—The washing test, to determine the stability of the tannage to the effects of hot, soapy water, was run in a "Launder-Ometer"* similarly to the test applied to textiles (4). This machine holds pint jars containing the soap solution and leather samples together with steel balls for mechanical action, and tumbles them end over end in a thermostatically controlled water bath. The data shown in Table II give results obtained by washing 3 pieces of leather (2" x 2½" each) in 200 ml. of 0.5% Ivory soap solution (pH about 10). The washing cycle was for ½ hour at 120°F. All three samples were

*Mention of brand or firm names does not constitute an endorsement by the Department of Agriculture over others of a similar nature not mentioned.

TABLE I

LEATHERS FROM 24-HOUR TANNING OF SYRIAN SHEEPSKIN

	Tannage[a]			Ts of Leather		Analysis (MFB)[e]					
No.	Aldehyde[b] %DPW	pH[c]	Aldehyde Consumed[d] %	Tanned °C.	Finished °C.	N %	Fat %	Ash %	Hide Subs. N × 5.62 %	Balance %	Fixed Aldehyde[f] mmoles/gHS
						Glutaraldehyde, 25% solution					
1	6	2.4	55	72	71	12.06	26.10	0.52	67.78	5.60	0.33
2	10	2.5	50	77	73	12.80	23.17	0.46	71.94	4.43	0.50
3	12	4.1	74	81	77	12.73	19.93	0.79	71.54	7.74	0.89
4	24	4.1	38	80	77	11.51	25.28	0.89	64.67	9.16	0.91
5	6	5.1	90	81	76	12.17	25.80	0.49	68.40	5.31	0.54
6	12	5.0	70	82	76	11.63	26.43	0.72	65.36	7.49	0.84
7[g]	12	4.8	63	81		11.44	26.96	1.12	64.29	7.63	0.76
8	24	5.0	46	82	78	11.50	26.30	0.51	64.63	8.56	1.10
9	6	6.3	95	77	74						
10	6	6.3	96	79	77	12.37	23.70	0.48	69.52	6.30	0.58
11	12	6.4	90	82	77	12.28	22.90	0.44	69.01	7.65	1.08
12	24	6.1	56	82	78	11.56	25.43	0.47	64.97	9.13	1.34
13	6	8.3	98	81	76	11.92	24.25	0.49	66.99	8.27	0.59
14	6	8.4	99	82	77	12.88	21.05	0.42	72.39	6.14	0.59
15	12	8.4	95	82	79	13.16	19.07	0.42	73.96	6.55	1.14
16	24	8.2	66	78	78	11.55	25.33	0.47	64.91	9.29	1.58
17	6	9.8	99	77	78	11.88	26.00	0.52	66.71	6.71	0.58
18	12	9.2	97	83	77	11.86	24.60	0.50	66.65	8.25	1.16
19	24	9.0	91	81	79	12.44	19.73	0.49	69.91	9.87	2.18
						Formaldehyde, 37% solution					
20	4.9	4.8	34	78	72	11.22	30.43	0.90	63.06	5.61	0.82
22	4.9	8.0	44	83	79	12.34	24.80	0.86	69.35	4.99	1.06
23	4.9	9.4	49	84	78	12.83	21.83	0.94	72.10	5.13	1.18
						Glyoxal, (pure) 30% solution					
24	5.8	4.8	6	58		No tanning effect					0.07
25	5.8	8.1	72	75	73	11.36	28.38	1.19	63.84	6.59	0.86

a For details of tanning refer to same experiment number in Table I of preceding paper (1).
b As the aqueous solution of commerce. DPW signifies drained pickle weight.
c Value at end of 24-hours tanning.
d Calculated from the initial and final concentration of aldehyde in tanning liquor. Expressed as percent of aldehyde input.
e Analysis of finished leather.
f Fixed aldehyde at equilibirium was calculated from aldehyde consumed; assuming 25% of drained pickled weight to be hide substance.
g 200% water instead of 100% as in others.

TABLE II

PROPERTIES OF SYRIAN SHEEPSKIN TANNED WITH GLUTARALDEHYDE

Exp. No.	Tannage[a]		Ts[b] °C.	Washability Ts, °C. after Wash			ΔTs[c] °C.	Perspiration Resist. Shrinkage, %	Stitch-Tear Strength Parallel		Perpendicular	
	% DPW	pH		1	2	3			lb.	lb/in	lb.	lb/in
						Glutaraldehyde						
1	6	2.4	71	65	65	63	8	77	22.5	589	22.3	535
2	12	2.5	73	66	67	66	7	65	23.9	450	30.3	527
3	12	4.1	77	73	71	71	6	34	13.6	227	13.6	259
4	24	4.1	77	76	74	73	4	21	9.5	223	4.4	131
5	6	5.1	76	74	72	67	9	24	26.5	629	28.5	571
6	12	5.0	76	76	74	70	6	4	20.1	464	17.2	376
8	24	5.0	78	77	76	73	5	3	16.4	416	21.4	499
9	6	6.3	74					34	23.2	427	28.5	533
10	6	6.3	77	78	73	73	4	4	11.7	310	15.3	401
11	12	6.4	77	76	75	73	4	1	19.2	456	21.2	499
12	24	6.1	78	77	77	75	3	1	22.1	376	20.1	376
13	6	8.3	76	74	74	71	5	34	20.1	444	20.1	426
14	6	8.4	77	77	73	72	5	6	16.6	454	17.9	494
15	12	8.4	79	80	78	77	2	3	30.3	442	30.5	414
16	24	8.2	78	78	76	75	3	1	13.3	291	16.1	305
17	6	9.8	78	76	75	71	7	48	16.1	333	13.9	312
18	12	9.2	77	78	77	73	4	1	29.2	442	32.7	464
19	24	9.0	79	78	77	74	5	1	20.1	426	20.8	462
						Formaldehyde						
20	4.9	4.8	72	67	65	61[d]	11	[e]	14.8	376	18.5	417
22	4.9	8.0	79	74	73	66	13	[e]	27.1	485	27.3	451
23	4.9	9.4	78	74	73	71	7	[e]	30.4	548	19.2	397
						Glyoxal						
25	5.8	8.1	73	67	67	67[d]	6	77	7.9	288	14.3	466

a For details refer to same experiment number in Table I. pH is value at end of 24 hours.
b Ts of finished leather.
c ΔTs refers to the change in the Ts after three washes.
d The washed leather samples from these tests were very stiff, and mechanical action showed but little improvement in softness.
e Completely unstable.

washed together and given three wash cycles, the specimens being rinsed and air-dried after each cycle. The shrink temperature (Ts) of the washed samples was determined after each cycle. The air-dried leathers after each wash were also examined for leather character.

Strength properties—Specimens were cut from the selected test area (W) for determination of stitch-tear strength. The same location on each skin was chosen, and two adjacent specimens were tested. The double-hole stitch-tear test method (5) was used, and the data are shown in Table II.

Analyses—The leathers were ground in a Wiley mill, and standard methods of analysis were employed. Total nitrogen was determined by the semi-micro Kjeldahl method (6). Moisture and ash were determined by the official ALCA methods (7). The fat content of the finished leathers was determined after hydrolysis of the leather sample (8). The leather was hydrolyzed by refluxing in 4*N* HCl, and the hydrolyzate was extracted with Skellysolve B. Evaporation of the solvent gave an estimate of oil content. This procedure gave fat values 2 to 4% higher than those obtained by chloroform extraction of the leather (9).

The results are summarized in Table I.

Eight-Hour Tannages

The 24-hour tannage was used to study the rate of reaction of glutaraldehyde with collagen. From a practical standpoint a shorter time is desirable. Precautions must be taken, however, to avoid drawing the grain from too rapid a tanning action at the beginning. This can be accomplished by adding the glutaraldehyde in feeds or by controlling the pH. The procedures outlined below produced smooth-grained, well-let-out sheepskin leather in our tests.

Feed control.—This test was conducted on 12 cabretta skins. Based on drained pickled weight, the procedure was as follows:

Pickled skins (6300 g.)	100%
Water	100%
NaCl	6%
Glutaraldehyde (25% aqueous solution)	4%
Drum ½ hour, pH 2.3	
Add sodium acetate (anhyd.)	6%
Drum 1 hour, pH 5.0, Ts 77°C.	
Add glutaraldehyde 25% solution)	8%
Drum 6 hours, pH 5.0, Ts 84°C.	
Wash ½ hour	
Drain	

pH control—This test was carried out with 3 cabretta skins according to the following procedure:

Pickled skins (2115 g.)	100%
Water at 90°F.	100%
NaCl	6%
Glutaraldehyde (25% aqueous solution)	12%
Drum ½ hour, pH 2.3	
Add sodium formate (anhyd.)	4%
Drum 2 hours, pH 4.0, Ts 79°C.	
Add $NaHCO_3$	3%
Drum 1½ hours, pH 6.6	
Add $NaHCO_3$	0.5%
Drum 2 hours, pH 7, Ts 82°C.	
Add formic acid (90% solution)	1.75%
Drum ½ hour, pH 4.4	
Wash ½ hour, Ts 83°C.	

DISCUSSION

The preceding paper (1) presented data showing that glutaraldehyde was an unusual aldehyde with regard to its tanning properties. The present study shows that the leather also exhibits some unusual properties in comparison to conventional aldehyde leathers such as formaldehyde and glyoxal. The data discussed below were obtained for 24-hour tannages with the laboratory drum turning intermittently overnight.

No difficulty with the glutaraldehyde leather was experienced in the fat-liquoring and other usual posttanning operations given the regular chrome garment leather. Soft, mellow leather of a pleasing character was obtained from every test which covered the pH range from about 2.5 to 10, and with concentrations of glutaraldehyde (100% basis) as low as 1.5%. Consumption of aldehyde (Table I) becomes practically quantitative in the pH region above 6.

The shrinkage temperature of these aldehyde leathers was lowered slightly by the conventional posttanning operations given chrome garment leather. However, the shrinkage temperature of the glutaraldehyde-tanned leathers was as high as, or higher than, those leathers tanned with formaldehyde or glyoxal under comparable conditions. As judged by the tanner, glutaraldehyde produced leather far superior in appearance and feel to that from formaldehyde or glyoxal.

It was hoped that analysis of the leather would enable calculation of fixed aldehyde from the balance remaining over and above the hide substance, fat, and ash. Unfortunately the finishing operation, such as syntan bleach used on the regular leather, apparently contributed added fixed substances,

as is evident from the high balance figures for the formaldehyde-tanned leathers (Table I). Direct determination of formaldehyde in the finished leather by the method of Highberger and Retzsch (10) gave values of 0.20, 0.37, and 0.60% formaldehyde (MFB) for the leathers in tannage Nos. 20, 22, and 23, respectively (Table I). This data expressed as millimoles per gram of hide substance gave fixed formaldehyde contents of 0.11, 0.18, and 0.28, respectively. These values are considerably less than formaldehyde fixed by the skin in equilibrium with the tanning liquor (column 12, Table I) as calculated from aldehyde consumed during tanning. This difference is most likely accounted for by the reversible nature, at least in part, of the tannage. Unfortunately, a method for the direct determination of glutaraldehyde in leather is not unavailable, and comparison of the reversible nature of these two tannages is not possible. It is interesting to note that fixation of these two aldehydes at equilibrium, as calculated from aldehyde consumed during tanning under similar conditions, was very near the same (compare last column of Table I for tannage Nos. 6, 15, and 18 with 20, 22, and 23). Fixed aldehyde at equilibrium varied from about 0.82 to 1.18 millimoles per gram of hide substance in the pH range studied, i.e., 5.0 to 9.4.

Various properties of the finished leathers are summarized in Table II. This stitch-tear data were collected on a limited number of specimens. However, the data indicate reasonably satisfactory strength properties.

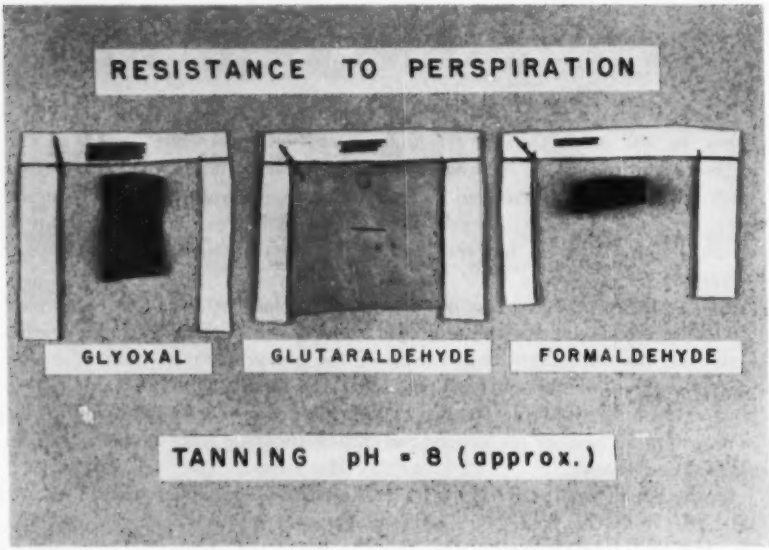

FIGURE 1.—Photograph of test specimens of glyoxal, glutaraldehyde, and formaldehyde sheepskin leathers after perspiration test.

An unexpected property of the glutaraldehyde-tanned leather was the perspiration resistance of this tannage, as measured by area change caused by the synthetic perspiration test proposed by Colin-Russ (3). Tannage with glutaraldehyde at the 12% level at pH 5 and above produced leather which showed unusually good resistance to this test. As shown in Table II, these leathers underwent only a 1 to 6% area shrinkage when tested with the synthetic perspiration. Furthermore, these leathers retained their leather character, such as softness and flexibility, after exposure to this test. This behavior is in marked contrast to formaldehyde and glyoxal. These latter two aldehydes when used in tanning under the same conditions as for glutaraldehyde, produced leathers that were severely shrunken and embrittled by the synthetic perspiration as shown in Table II. This characteristic is shown more clearly in Fig. 1.

It was of interest to note (Table II) that the glutaraldehyde tannage carried out at pH 4 and below did not result in a perspiration-resistant leather. With one exception, perspiration resistance was not a noteworthy property of the leathers tanned with 6% of the aqueous (25%) glutaraldehyde solution on the drained pickled weight. This exception was noted when sodium sulfate was used in place of sodium chloride in the tannages carried out at pH 6.5 and 8 (experiments 10 and 14, Table II). This behavior, or salt effect, is difficult to explain either on the basis of aldehyde consumed at equilibrium (Table I) or by analogy with salt effects on formaldehyde tanning (11, 12).

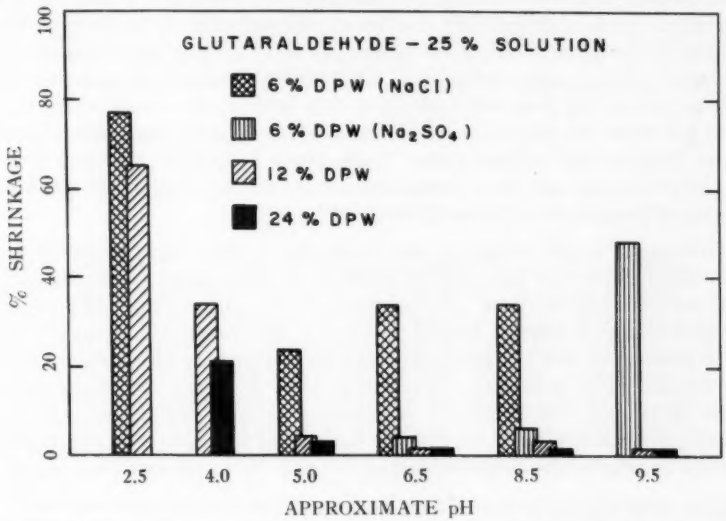

FIGURE 2.—The influence of various tanning factors on the perspiration resistance of glutaraldehyde-tanned sheepskin leathers.

The bar graph (Fig. 2) shows at a glance the influence of various tanning factors on the perspiration resistance of glutaraldehyde-tanned sheepskins.

The resistance of the glutaraldehyde tannage to hot soap solution also was determined in order to evaluate the tannage from a washability standpoint. In this instance the change in shrinkage temperature of the leather was used as a criterion of stability. After the test, the specimens were examined for leather characteristics. The results in comparison with formaldehyde were not so marked as in the case of the perspiration test. The data (Table II) indicated that glutaraldehyde leather was more resistant to "detannage" than the corresponding formaldehyde or glyoxal leathers. Only at the highest pH of tannage (9.5 to 10) was the shrinkage temperature of the washed formaldehyde leather comparable to that in the case of glutaraldehyde. In the tannages carried out at lower pH the glutaraldehyde leathers were distinctly more resistant to lowering of the shrinkage temperature by hot soapy water. All the washed leathers were firmer after drying than the unwashed samples. However, a slight mechanical action readily restored the soft flexible character to the glutaraldehyde-tanned leathers.

A 24-hour tannage is not practical for commercial drum tanning. In tests of the glutaraldehyde tannage with small packs it was found that with the drum at rest overnight streaks of color developed on the surface of the leather. The rate studies in the previous paper (1) clearly show that tanning can be accomplished in much less than 24 hours and that overnight tannage is not necessary. In fact under some conditions tanning with glutaraldehyde appears to be complete in one or two hours. However, if tanning is carried out too rapidly, drawn grain is obtained. This can be avoided by proper control, such as adding the glutaraldehyde in several feeds or by careful regulation of the pH when the aldehyde is added in one feed. The two procedures listed in the Experimental section under "Eight-Hour Tannages" illustrate these methods of control and were found satisfactory for avoiding drawn grain in tanning of sheepskins in the laboratory.

With regard to pH control it was found that a pH of approximately 4.2 was critical to prevent drawn grain when all the glutaraldehyde at the 12% level was added in one feed. Sodium formate was an excellent buffer which provided almost automatic control just below the critical pH. One or two hours tanning at this pH permitted sufficient fixation so that drawn grain was avoided upon subsequent elevation of pH. A shrink test in the early stages of tanning was helpful in determining suitable tanning procedures. Drawn grain was avoided if the tanning was carried out under conditions such that the Ts reached the neighborhood of 70° to 75°C. in the first hour or two.

These observations were made on small packs of sheepskins tanned under laboratory conditions. Some adjustments may be necessary to arrive at optimum conditions with other raw stock and in full pack tests. The rapid

tanning action of glutaraldehyde is a property that may be of interest in producing textured grain leather.

Completion of the tannage within eight hours, including removal of unused glutaraldehyde by washing, completely eliminated the problem of streaked leather. The leathers tanned in eight hours showed substantially the same properties as those tanned for 24 hours.

Because of its ability to tan over a wide pH range, glutaraldehyde was found to be compatible in combination tannages with other conventional tanning agents, with an enhancement of leather properties.

REFERENCES

1. Fein, M. L., Harris, E. H., Jr., Naghski, J., and Filachione, E. M. *JALCA*, **54,** 488 (1959).
2. ALCA Provisional Method J1, April, 1953.
3. Colin-Russ, A. *J. Intern. Soc. Leather Trades' Chemists*, **31,** 329 (1947).
4. *Year Book of the American Association of Textile Chemists and Colorists*, 1947–1948, p. 102. Test No. H: Colorfastness of Textiles to Commercial Laundering and Domestic Washing.
5. ALCA Provisional Method E13, April, 1953.
6. Willits, C. O., and Ogg, C. L. *J. Assoc. Offic. Agr. Chemists*, **33,** 179 (1950).
7. ALCA Provisional Methods B3 and B15, June, 1957.
8. Koppenhoefer, R. M. *JALCA*, **32,** 627 (1932).
9. ALCA Provisional Method B4, June, 1957.
10. Highberger, J. H., and Retzsch, C. E. *JALCA*, **33,** 341 (1938).
11. Bowes, J. H., in *Progress in Leather Science*: 1920–1945 (London: British Leather Manufacturers' Research Assoc., 1948) Chap. 25, p. 515.
12. Nayudama, Y., Jayaraman, S. K., and Krishnan, T. S. *JALCA*, **52,** 238 (1957).

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DISCUSSION

DR. LUDWIG SELIGSBERGER (Quartermaster Research and Engineering Center): The experiments and observations of Dr. Filachione, I think, should enable chemists in any industrial laboratory to employ glutaraldehyde intelligently and to learn by themselves what they can do with the material.

The authors who share the honor of this type of painstaking study—I am thinking here particularly of following the pickup of the aldehydes quantitatively over an extended period of time—are to be warmly commended. It is also gratifying to know that the work was done mostly on whole skins and that we can inspect the leather produced.

The most impressive result, in my opinion, is the speed of the glutaraldehyde fixation. The reason, I think, is because glutaraldehyde is monomeric in the 25% commercial solution, whereas glyoxal and formaldehyde are more

or less aggregated at the concentrations employed, and the aggregated portion returns to the monomeric form gradually after dilution in the tanning drum. The question of whether the monomeric forms differ in their rate of tanning is theoretical but may one day be answered by a properly designed laboratory experiment.

It was rather unexpected for me to see that the shrinkage maxima for all three aldehydes were lower than in some experiments I conducted on cowhide side leather. The difference was lowest with glutaraldehyde and somewhat higher with formaldehyde. We know from the literature that we can reach 90° or 91°C. with formaldehyde and that we can also reach 89° or 90°C. with glyoxal under proper conditions. That is why I think that the laundering and perspiration tests with those two aldehydes are not as conclusive as they are with glutaraldehyde. It may be possible to get about the same results, but I have no data to prove that.

I also want to mention that in some experiments I conducted, I got a brown color on the outside of the glutaraldehyde, but the inside was light—very light, almost white.

DR. PETER R. BUECHLER (Rohm & Haas Co.): I was very much interested in the observation that this leather is more resistant to perspiration, because one of the difficulties with formaldehyde-tanned leather, as commercially made, is the difficulty in drying out that leather without getting shrinkage. I wonder if you have any comparative data to indicate whether or not glutaraldehyde-tanned leather will give a better area yield on drying after tannage.

DR. FILACHIONE: You mean a better area yield than formaldehyde-tanned skin?

DR. BUECHLER: Yes.

DR. FILACHIONE: No, we have no data along that line.

Incidentally, in connection with Dr. Seligsberger's comments, I think he is absolutely right that you could expect a shrink temperature of around 90°C. for formaldehyde leather. However, the sheepskins that we used had a shrink temperature in the untanned state of around 50°C., which is about 10° lower than that usually observed for cowhide. For this reason the Ts would not be elevated as high in the case of these sheepskins as it would with other stock, such as cowhide.

In our tests with sheepskins the color of the tanned skin was fairly uniform throughout the thickness. As the pH of tanning was increased we got more color developed in the leather, but it was more or less distributed throughout the thickness.

One of these leather jackets that I have here is finished in the natural color and you will see it is a light, cream-colored leather.

DR. SOMERVILLE: How does this tannage behave as regards coloring dyestuffs and fatliquoring?

DR. FILACHIONE: We don't have too much data on its behavior to dyestuffs. One of these jackets is in charcoal gray. The leather accepted this color very well. In another case we have seen a piece of chrome-tanned leather and one of glutaraldehyde-tanned leather which were colored together with a red dye. The glutaraldehyde leather was considerably brighter in color than the chrome leather. In fact, the chrome-tanned leather looked orange-colored compared to the bright red color of the glutaraldehyde specimen.

With regard to fatliquoring, they were given the regular fatliquor that is given to the chrome-tanned leather. The tanner reported no difficulty; in fact he thought the fatliquor was very uniformly distributed in the leather.

MRS. JEAN TANCOUS (University of Cincinnati): Would it be considered a washable leather?

DR. FILACHIONE: I should emphasize that we have only preliminary data. We think they indicate the comparative stability of the tannage to washing. We have put regular chrome-tanned garment leather through the same wash test, and the shrinkage temperature went down considerably more than did the glutaraldehyde-tanned leather. Even though the chrome-tanned leather was initially at a higher shrinkage temperature than the glutaraldehyde leather, after the third wash its shrinkage temperature was below that of the glutaraldehyde.

RICHARD N. JONES (A. C. Lawrence Leather Co.): Which one of the four A.A.T.C.C. tests was used? Specifically, what temperature and soap concentration?

DR. FILACHIONE: We used the test corresponding to A.A.T.C.C. Method No. 2. The specimens were washed in a 0.5% soap solution at 120°F. for ½ hour.

THE STABILITY OF LEATHER UNDER TROPICAL STORAGE CONDITIONS

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ABSTRACT

An investigation was conducted on salvaged boots returned from the Southwest Pacific after the war because they were found unfit for issue to troops when the packing cases were opened. In order to determine the cause of the degradation in storage, the Army Retan upper leather was examined by routine physical and chemical test methods. The leather was divided into six lots on the basis of its strength losses; these losses were found to be closely correlated to the quantities of alkali-soluble nitrogen present. The shrinkage temperature declined and the number of amino acids in the hydrolyzed aqueous and 2*N* hydrochloric acid extracts of the leather increased in the same rank order. Before hydrolysis the same extracts were found to be devoid of individual amino acids. The significance of these findings is discussed, particularly as they compare with the results of other workers on the "shelf-life" of combination-tanned bookbinding leather in the temperate zone and on accelerated aging tests under simulated tropical conditions.

INTRODUCTION

During World War II the storage under unfavorable climatic conditions of military items partially or wholly made of leather was unavoidable. Particularly in the Southwest Pacific area (SWP) thousands of pairs of boots in storage were found to be unfit for wear when the packing cases were opened. Not only were the uppers covered with mildew, but also some of the leather was so tender it could be torn apart by hand. This experience led the U. S. Army Quartermaster Corps to initiate studies of the nature of leather degradation and possible means of extending storageability (1–5). An investigation was also conducted on the upper leather of salvaged boots in order to learn more about the nature and causes of their failure.

Despite the many studies on the subject, our knowledge of what causes leather to deteriorate is still fragmentary. Although progress in this field is slow, every bit of information plays its part in advancing our understanding of it. The Quartermaster investigation on salvaged upper leather exemplifies a type of study begun for practical reasons that provides some information on the deterioration process.

EXPERIMENTAL

A shipment of about 200 pairs of boots in unopened cases was returned from the SWP for the purpose of this investigation. The upper leather removed from these boots was considered representative of the combination chrome-vegetable tannage known as Army Retan which was in use at the time. In the examination of this leather, two approaches were taken. In the first place, the usual physical and chemical tests were performed on the leather from each boot in order to rank it according to the seriousness of the damage. Secondly, an attempt was made to link the damage to a breakdown of the collagen by employing chromatographic techniques.

In the first phase of the study, the burst strength of the upper leather parts was taken as the basis for dividing them into six lots, as shown in Table I. A composite sample was then prepared from leather representing each lot for chemical analysis. The following determinations were performed according to Federal Specification KK-L-311 (6): stitch-tearing strength, shrinkage temperature, hide substance, chromic oxide, grease, and pH. For bursting strength, a 1/8″ plunger in conjunction with a 3/8″ orifice was used. Alkali-soluble nitrogen was extracted with 0.1*N* sodium carbonate (7).

In the second phase of this study, a chromatographic analysis was made of each lot of leather in an attempt to discover what relationship might exist between the degree of physical deterioration and the order of hydrolysis of amino acids. Duplicate samples of each of the six lots were extracted, one with water and the other with 2*N* hydrochloric acid solution. After hydrolysis, the extracted material was identified by means of paper chromatography using the following procedure:

One gram of leather was thoroughly moistened with 20 ml. of the extraction medium. After standing at room temperature for 16–20 hours, the leather was filtered and washed several times with fresh portions of the extraction medium. The extracts and washings were combined and brought to dryness on a steam bath, a process which required approximately 6 hours. The residues were dried overnight in a desiccator, dissolved in 2 ml. of a 10% aqueous solution of n-propylalcohol, and analyzed in triplicate by means of two-dimensional ascending chromatography, using 0.02 ml. of the total volume for each determination.

TABLE I

STRENGTH AND SHRINKAGE MEASUREMENTS ON ARMY RETAN LEATHERS

Lot	Bursting* Load lb.	Bursting* Strength lb./in.	Stitch-Tear* Strength lb.	Stitch-Tear* Strength lb./in.	Ts °C.
		Southwest Pacific Storage			
1. (Strongest)	101	1140	75	830	85
2.	85	880	60	630	83
3.	67	690	49	520	77
4.	50	530	35	370	74
5.	39	400	20	210	74
6. (Weakest)	26	230	10	120	73
Average	61	640	42	450	78
		Tropical Chamber Storage of Ten Production Lots†			
Before storage	112	1320	—	—	108
After 3 years	63	690	—	—	81
		Tropical Chamber Storage and Accelerated Aging Test of Five Production Lots (4)‡			
Before storage	74	—	78	—	100**
After one year in chamber	61	—	65	—	97**
After 10 months at 35°C. and 100% rel. humidity in sealed jars	52	—	42	—	90**

*Each figure represents the mean value of at least 16 measurements.
†Each figure represents the mean value of at least 160 measurements.
‡Each figure represents the mean value of 60 measurements.
**In water.

The remainder of the alcoholic solution of the water-extracted residue was treated with 8 ml. of 6*N* hydrochloric acid, again brought to dryness on the steam bath, dried overnight in a desiccator, and dissolved as described before for a second chromatographic analysis.

All leather extractions were made in duplicate. Additional extractions with 2*N* hydrochloric acid on the two weakest lots were evaporated under vacuum at room temperature instead of being heated on the steam bath. The residues were dissolved in 2 ml. of a 10% solution of n-propylalcohol and analyzed chromatographically as follows.

Chromatographic analysis.—Two-dimensional ascending chromatographic analysis was run in an airtight cylindrical apparatus; 0.02 ml. of the alcoholic solution was applied to a piece of Whatman #1 filter paper (6½″ x 6″ or 12″ x 12½″), ½″ from the side of the paper and ¾″ up from the

bottom. The paper was formed into a cylinder and placed in the chromatographic apparatus containing a butanol–acetic acid–water solvent (8). When the solvent had reached the top of the paper (in 3 to 4 hours for the small paper and overnight for the large one), the cylinder was removed and air-dried at room temperature. The two-dimensional chromatogram was made by rolling the paper at right angles to the first direction of flow, placing it in another cylindrical apparatus containing a 1-to-1 m-cresol-phenol mixture at pH 9.3 (9). After the second solvent came within ½" of the top of the paper (advancing at the same speed as the first), the cylinder was removed and allowed to stand at room temperature overnight.

The chromatograms were then treated with a 0.4% solution of ninhydrin* and developed at 100°C. for three minutes. The reaction areas were compared with those obtained by chromatographing a synthetic amino acid mixture and a hide powder hydrolyzate. In the case of the hide powder it was possible to identify all the known amino acids in collagen with the exception of isoleucine and hydroxylysine.

RESULTS

Physical properties.—The average strength properties and shrinkage temperatures of the six lots of SWP leather are shown in Table I. For comparison the table also includes results obtained in the tropical chamber of the QM Research and Engineering Center (10), as well as data extracted from the report of Lollar (4). The climatization chamber results are averages of ten production lots of Army Retan upper leather in the so-called USXL series (11), representing a desired chrome level of 6.5%, on hide-substance basis, but with variations in grease and retan levels. The specimens were treated for mildew resistance by swabbing with p-nitrophenol before they were placed in the chamber. The figures taken from Lollar's report allow a direct comparison between storage of almost equal duration in a tropical chamber and in an accelerated laboratory test. All figures are mean values of measurements comprising specimens treated and not treated against mildew. Lollar showed that the fungicidal treatment had no effect on leather stability.

Chemical composition.—The chemical analysis of the SWP leather is presented in Table II. This table also contains unpublished figures on the chemical composition of the Army Retan leather in the tropical chamber test cited in Table I.

Chromatographic results.—The aqueous and the 2*N* hydrochloric acid extractions of newly tanned Army Retan leather contained only 0.17 and 0.48% respectively of its total nitrogen. After acid hydrolysis these extractions showed no ninhydrin reaction spots on their chromatograms.

*In normal butanol containing 4 g. glacial acetic acid/100 ml.

TABLE II

CHEMICAL COMPOSITION OF DETERIORATED ARMY RETAN LEATHERS

Lot	Percent on Dry Basis			Alkali-soluble Nitrogen in % of Total Nitrogen	pH
	Hide Substance	Chromic Oxide	Grease		
		Southwest Pacific			
Lot 1 (Strongest)	56.6	2.8	13.2	2.8	3.0
Lot 2	56.8	2.8	13.0	3.4	2.9
Lot 3	55.3	2.3	12.9	4.3	2.9
Lot 4	58.2	2.1	10.0	6.2	2.8
Lot 5	59.1	2.2	7.1	8.6	2.8
Lot 6 (Weakest)	57.3	2.6	5.3	11.1	2.9
		*Tropical Chamber**			
Before storage	49.6	3.1	30.1	—	3.0
After 3 years	—	—	27.6	—	3.1

*Leather was treated with paranitrophenol.

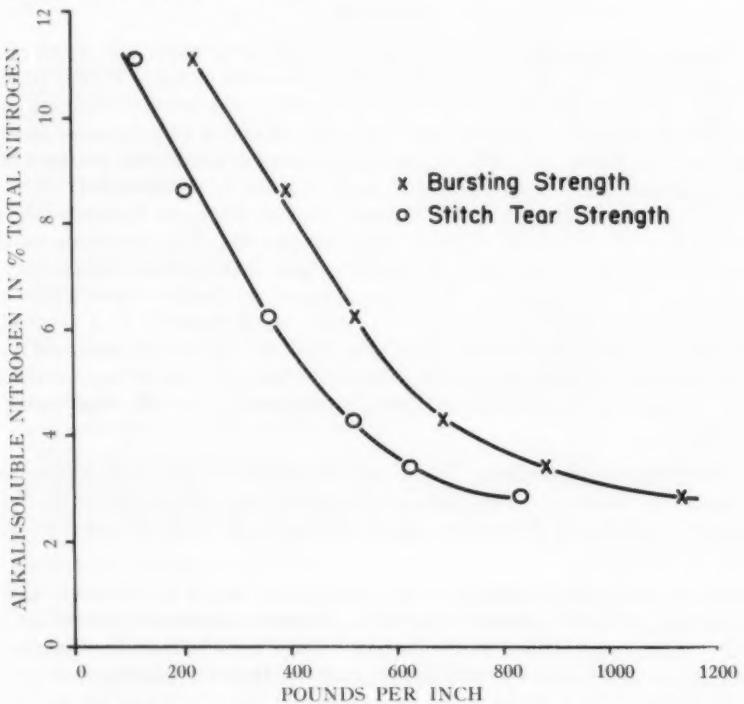

FIGURE 1.—Strength versus alkali-soluble nitrogen in Army Retan after S.W. Pacific storage.

The aqueous extract of the strongest SWP leathers contained about nine times as much soluble nitrogen as the freshly tanned Army Retan. As the strength losses increased, so did the soluble nitrogen. In the hydrochloric acid extracts, the soluble nitrogen rose more steeply from lot to lot than in the aqueous extracts, presenting a curve similar to that depicted in Fig. 1 for alkali-soluble nitrogen.

TABLE III

AMINO ACIDS IN THE HYDROLYZATES OF EXTRACTS OBTAINED FROM DETERIORATED ARMY RETAN LEATHER

Amino Acid	Collagen, g/100 g (12)	Lot 1	2	3	4	5	6
Glycine	26.1	○	○	○	●	●	●
Alanine	10.1	○	○	○	●	●	●
Leucines	5.6		○	○	○	○	○
Valine	3.0				○	○	○
Proline	14.8			○	○	●	●
Hydroxyproline	12.4				○	○	●
Phenylalanine	2.9			○	○	●	●
Tyrosine	1.1					○	○
Arginine	8.9				○	○	○
Lysines	5.0					○	○
Aspartic Acid	6.6			●	●	●	●
Glutamic Acid	11.3			●	●	●	●
Frequency of amino acid identification							
(*a*) hydrochloric acid extractions		2	3	7	10	12	12
(*b*) aqueous extractions				2	4	6	7

○—amino acid found in hydrochloric acid extracts
●—amino acid found in aqueous and hydrochloric acid extracts

Chromatograms obtained from these extractions showed only negative ninhydrin reactions. Evidently the extracted nitrogenous constituents still are of high molecular weight. Negative ninhydrin reactions were obtained even on those acidic extracts which, as noted above, were evaporated to dryness under vacuum before being tested chromatographically. This observation is comparable to that of Kanagy that alkali-soluble nitrogen fractions of deteriorated leather could still be precipitated by phosphotungstic acid or tannin (7).

After hydrolysis, the aqueous extracts of the SWP leather showed strong, positive ninhydrin chromatograms, the number of amino acids identified increasing as the strength of the lots decreased. The hydrolyzed hydrochloric

acid extractions showed the same trend beginning with the strongest lot. The amino acids identified in these hydrolyzates are shown in Table III, arranged in four groups of which the first consists of the nonpolar amino acids; the second, the aromatic ring compounds; the third, the two basic amino acids; and the fourth, the two acidic amino acids.

Of the 12 amino acids found, seven appeared in the hydrolyzates of the water extracts and all 12 in the hydrolyzates of the hydrochloric acid extractions. Three amino acids (serine, threonine, and methionine) could not be identified in any hydrolyzate. The presence of histidine in the hydrolyzate of the acid extraction of the three weakest lots was doubtful; therefore it was not included in the table. In no case, however, did the hydrolyzate of the aqueous extractions contain an amino acid that had not been identified in the hydrolyzates of the hydrochloric acid extractions. The arrangement of Table III not only shows at a glance which amino acids were present in the hydrolyzates of the different lots, but also the frequency of their occurrence.

DISCUSSION

Physical properties.—The figures of Table I give a measure of the breakdown of SWP leather, compared with aging effects observed on Army Retan in the tropical QM climatization chamber and in an accelerated aging test under hot-humid conditions. In all three instances strength and shrinkage resistance were drastically lowered. The average strength of the SWP leather is approximately equal to that of ten production lots after storage for 3 years in the tropical chamber. However, the weakest lots of the SWP leathers rank far below any of the leathers aged artificially. The strongest lot, on the other hand, is about as strong as new leather, but its T_s is well below normal for Army Retan. The initial strength of Lollar's five production lots is low for new Army Retan, and after accelerated aging, it is of the same magnitude as the strength of the SWP leather and of the USXL lots after 3 years of tropical storage. The T_s decrease in sealed jars is rather small, indicating that chemically the breakdown is not the same in the sealed jars as in the tropical chamber or in the SWP.

Chemical composition.—The analyses figures presented in Table II show that alkali-soluble nitrogen rises sharply from Lot 1 to Lot 6 as the strength decreases. The grease content is low in all lots, as compared to new leather, and gradually decreases further in the weaker lots. The other chemical properties shown, hide substance, chrome, and pH, do not seem to be related to the ranking by strength.

Grease.—A minimum of 18% grease was required in the specification BQD No. 132, valid at the time when the shoes were manufactured. A review of test reports indicated that leather generally met this requirement; therefore

it is apparent that much of the grease has been lost, probably because of the growth of mildew. The very severe grease losses of the weaker lots certainly are caused by mildew. The role of grease in leather as a nutrient for fungi has been clarified in earlier studies (4, 13). They also showed that grease losses caused by mildew are not responsible for the strength losses which occur with treated and untreated specimens alike (4).

Alkali-soluble nitrogen.—A relationship between strength losses and alkali-soluble nitrogen has been postulated in the past by workers who studied the deterioration of bookbinding leather (14, 15). When vegetable leather was degraded by the absorption of mineral acid, it was possible to obtain a fairly good correlation between strength losses and extractable nitrogen. Combinations of vegetable and mineral tannages substantially reduced the quantities of alkali-soluble nitrogen formed on aging (16). However, no correlation could be established for many leathers after shelf exposure over periods of 12 to 18 years, as less than 0.5% of the total nitrogen was soluble, whereas strength losses ranged from 6 to 70%. On the other hand, the SWP leather in Table II showed between 2.8 and 11% alkali-soluble nitrogen. In Fig. 1 alkali-soluble nitrogen is plotted against strength in order to illustrate the close relationship between them. For the weaker lots the relationship appears nearly linear, but the two strongest lots, although about as strong as Army Retan leather is expected to be, still yielded substantial quantities of alkali-soluble nitrogen. The results indicated, therefore, that deterioration by exposure to a hot humid environment is fundamentally different from shelf exposure in the temperate zone.

Chromic oxide.—The six lots into which the SWP leathers were separated show different chrome levels but no trend with decreasing strength. This finding is in agreement with results of other studies. For example, it has been reported (10) that the rate of strength losses in the tropical chamber is not influenced by variations in the chrome level of Army Retan. Nor is this the case in the other climatization chambers.

Hide substance.—The values for hide substance in Table II include "alkali-soluble nitrogen" and, therefore, vary by only a few percent from one lot to another. Not shown in Table II are constituents comprising the chrome complex, the vegetable tannin and the water-soluble fraction which for each group was about 0.5% on the dry basis.

pH (acidity).—The pH of the strongest lot of SWP leather and the initial pH of the USXL leathers shown in Table II were the same. The slightly lower pH values of the other SWP lots may indicate that this leather originally had a lower pH and, therefore, lost relatively more strength in storage, or that it supported a more prolific growth of mold. The latter is the more probable interpretation. Mildew is known to cause a rise in pH

of leather (17). In the tropical chamber where the leather is aged without being attacked by mildew, the pH actually rose slightly from 3.0 to 3.1.

For the purpose of securing more information on this point, the pH figures in Lollar's paper (4) were averaged separately for untreated and treated leathers, before and after his aging tests. Under Lollar's experimental conditions the changes in pH were as follows:

(*a*) in the QM tropical chamber	
in the untreated leather	+ 0.06
in treated leather	+ 0.08
(*b*) in the accelerated aging test	
in untreated leather	− 0.28 (mold grew profusely)
in treated leather	− 0.16

Here, too, the pH rose in the QM climatization chamber, while it dropped in the laboratory test; this decrease, moreover, was almost twice as great with untreated than with treated leather. In the tropical chamber the pH increase of treated and untreated leathers was about the same; this could be expected, since Lollar remarks that he did not find mold growing on many specimens. The drop in pH of treated leather while being aged in the laboratory was confirmed by Roddy and Jansing (5). Although their test extended only over 16 weeks, the decreases were about the same as found by Lollar.

One characteristic of accelerated aging tests which may be of importance in connection with pH changes during aging is that in sealed jars the atmosphere is stagnant, while in the chambers fresh air constantly circulates around the leather, carrying off any gases and volatile acids formed during aging. Army Retan containing vegetable tannins most certainly gives off some carbon dioxide, as straight vegetable leather does, according to Kanagy (18). Moreover, masking compounds like formic acid, if present, may gradually leave the chrome complex and escape from the surface of the leather. Both reactions would result in a trend toward higher pH values during prolonged storage of mildew-resistant leather in climatization chambers in agreement with the actual observations.

Chromatographic analysis.—The chromatographic procedures used on the SWP leathers represent an attempt to augment other results on the breakdown of these leathers and, within this limited scope, produced some interesting data, although of a purely qualitative nature. These results are shown in Table III.

The identification of the amino acids listed in this table was not hampered by streaking or lack of separation, as may have been expected because of the improvisations used in obtaining the hydrolyzates. In this respect, the technique may, therefore, be considered an improvement over the *modus*

operandi used recently by Bjorksten and Gottlieb in a somewhat related field (19). These authors, partially hydrolyzing chrome- and formaldehyde-tanned gelatin, could separate 12 or more amino acids by chromatographic analysis. Indirect evidence concerning the degree of hydrolysis reached in the chromatographic work on SWP leather may be cited from a paper by Greenberg and Burk (20). With gelatin, according to the authors, the rate of hydrolysis, in presence of 3*N* hydrochloric acid, is so rapid that 84.5% are hydrolyzed after 5 hours at 96°–98°C., e.g., under conditions approaching those in the chromatographic study of the SWP leathers. It is not unlikely that the aqueous and hydrochloric acid extractions of these leathers would be hydrolyzed even faster and more completely than gelatin itself and that, for this reason, excellent separation was obtained in all chromatograms.

As Table III shows, the number of amino acids appearing in the hydrolyzed aqueous and hydrochloric acid extractions closely follows the degree of deterioration. Once an amino acid was identified in the hydrolyzates from one of the six lots, it was also picked up in the extractions from any of the lots ranking lower in strength.

The strongest lot yielded, upon extracting with hydrochloric acid and hydrolysis, only the two most common nonpolar amino acids, glycine and alanine. The leucines appear in the second strongest lot. In the third lot proline and phenylalanine appear for the first time in the hydrochloric acid fraction, and aspartic and glutamic acids in both the aqueous and hydrochloric acid extractions. These two dicarboxylic acids are the only ones appearing simultaneously in both fractions. In Lot 4, three more amino acids, valine, hydroxyproline, and arginine, appear in the acid extraction; glycine and alanine make their first appearance in the aqueous extract. In Lot 5 tyrosine and the lysines completed the identification of the amino acids in the hydrolyzates. Lots 5 and 6 differed in that hydroxyproline was extracted only by hydrochloric acid extract from the fifth lot but could be extracted by both water and hydrochloric acid from the weakest lot.

A question still to be answered is why serine and threonine sequences were absent from the SWP leather extracts. In experiments on heat degradation of collagen Cassel (21) found that these two acids were among those most susceptible to oxidation. In the SWP leathers, perhaps the serine and threonine sequences in the water and hydrochloric acid-soluble fractions also degraded and, therefore, remained unidentified.

In this connection it is of interest that internal cross-linking through hydrogen bonds is, according to Gustavson, unfavorable to the fixation of vegetable tannins (22). In proteins like collagen that are rich in hydroxyamino acids, the OH-side chains form hydrogen bonds with other side chains containing $-COO^-$ and $\equiv NH^+$ groups (23). In the relatively rigid structure thus obtained, fewer sites are available for interaction with neutral molecules, such as vegetable tannins. It may well be that this non-participation

of serine and threonine in the binding of vegetable tannins is another reason why they do not appear in polypeptide fragments of deteriorated SWP leather.

Whichever explanation of their absence is correct, the usefulness of chromatography for investigating the breakdown of leather has been demonstrated in this preliminary study. Work on a larger scale is needed in order to develop more satisfying theories about the breakdown of leather stored and aged in various climates.

CONCLUSION

The degree of deterioration of Army Retan upper leather in SWP has been measured by various physical and chemical means. The leather was divided into six lots on the basis of declining strength measurements. It was observed that T_s decreased and alkali-soluble nitrogen increased as the strength of the leathers decreased. A fair correlation between physical breakdown and the number of amino acids in soluble polypeptide fragments was also found. This phenomenon of physical and chemical deterioration remaining parallel to each other has not as yet been matched fully by accelerated aging tests simulating a tropical climate on the same type of leather. Nor do combination-tanned bookbinding leathers after 12 to 18 years of shelf exposure in the temperate zone show a similar correlation between strength losses and soluble nitrogen.

REFERENCES

1. Barghoorn, E. S. *JALCA*, **45**, 688 (1950).
2. Greene, H. S., and R. M. Lollar. *JALCA*, **39**, 209 (1944).
3. Lollar, R. M. *JALCA*, **39**, 12, 179 (1944).
4. ———. *JALCA*, **49**, 605 (1954).
5. Roddy, W. T., and J. J. Jansing. *JALCA*, **49**, 773 (1954).
6. Federal Specification KK-L-311a (Washington 25, D. C.: Gen. Services Administration, 7th and D Streets, S.W., 1953): price $0.55.
7. Kanagy, J. R. *JALCA*, **32**, 12 (1937).
8. Partridge, S. M. *Biochem. J.*, **42**, 238 (1948).
9. Levy, A. L., and D. Chung. *Anal. Chem.*, **25**, 396 (1953).
10. Seligsberger, L., and C. W. Mann. *Chemistry and Technology of Leather*, ed. F. O'Flaherty, W. T. Roddy, and R. M. Lollar. (New York: Reinhold Publishing Corp., 1958) Vol. II, chap. 30, p. 498.
11. Zacharias, W. B., C. W. Mann, E. T. Steiner, and F. C. Horkowitz. *JALCA*, **48**, 460 (1953).
12. Cassel, J. M. *JALCA*, **51**, 229 (1956).
13. Wilson, H. R., H. B. Merrill, and W. M. Higby. *JALCA*, **49**, 404 (1954).
14. Innes, R. F. *Progress in Leather Science* 1920–1945 (London: British Leather Manuf. Assoc., 1948) p. 431.

15. Frey, R. W., and C. W. Beebe. *JALCA*, **29**, 490 (1934).
16. Beebe, C. W., R. W. Frey, and M. V. Hannegan. *JALCA*, **51**, 20 (1956).
17. Wilson, H. R., and H. B. Merrill. *JALCA*, **49**, 404 (1954).
18. Kanagy, J. R. *JALCA*, **46**, 609 (1941).
19. Bjorksten, J., and H. L. Gottlieb. *Study of Cross-Linkages in Gelatin* (Washington 25, D.C.: Air Force Office of Scientific Research, 1957).
20. Greenberg, D. M., and N. F. Burk. *J. Amer. Chem. Soc.*, **49**, 276 (1927).
21. Cassel, J. M. *JALCA*, **53**, 507 (1958).
22. Gustavson, K. H. *Chemistry of Tanning Processes* (New York: Academic Press, 1956) p. 197.
23. Klotz, I. M., and J. Ayers. *Discussions Faraday Soc.*, **No. 13**, 189 (1953).—Remarks by Gustavson, K. H. *Ibid.*, 234.

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Science affects the life of every contemporary man every day. It conditions decisions that need to be made by his government on many matters, including national defense, foreign policy and public health. It affects the decisions made by individuals on business problems, on selecting a community in which to live, on choosing an automobile, a record player, or perhaps even a dentifrice. If an individual is ignorant of science he must guess what to do or else believe what he is told. Even if he is told what to do by an expert, he has no way to check on this advice or even to understand it. This unhappy predicament is precisely that of most citizens of the United States today. Their fate in important matters and in trivial matters alike may thus be decided without their participation. And it will not be otherwise so long as they remain illiterate about science and technology. —*Education for the Age of Science*, President's Science Advisory Committee, 1959.

The scientist and the engineer form the team that paces today's technology. In science lie the foundations upon which the engineer builds toward a goal of the utility, comfort and advancement of man. He is concerned with machines, the environment in which they operate, and with the men who work with them and effect their control. In the broad sense the engineer derives from fundamental science the principles, the material properties and the analyses from which he synthesizes the system which is to achieve the objective, produce the result, create the product which is sought. In short, the engineer is the member of the technological team who creatively adapts the findings and methods of science to meet the needs and desires of manking.—*Education for the Age of Science*, President's Science Advisory Committee, 1959.

LIFE LINES

Brief Biographies of Our Contributors

HUBERTINA D. CLAYTON was graduated from the University of Philadelphia with a master of science degree in biochemistry after having completed her undergraduate work in biology and chemistry at Seton Hill College, Greensburg, Pa. She has been active in research on tanning and leather development since 1952 in the Leather Technology Laboratory Branch of the Quartermaster Research and Engineering Command.

MARTIN L. FEIN—See the September *Journal.*

DR. EDWARD M. FILACHIONE—See the September *Journal.*

EDWARD H. HARRIS, JR.—See the September *Journal.*

ALFRED H. KORN—See the April *Journal.*

F. P. LUVISI holds B.A. and M.A. degrees from Clark University, Worcester, Massachusetts. After several years in paper and leather industries he joined the U.S.D.A.'s Eastern Utilization Research and Development Division in 1941, where he engaged in research on domestic tanning materials and improvement of tanning processes. He has been a member of ALCA since 1943 and has served for several years on the Tannin Analysis Committee.

CHARLES W. MANN, a frequent contributor to this *Journal,* is a graduate of George Washington University. In 1941 he began working for the U. S. Department of Agriculture on hides, tanning materials, and leather. Five years later he joined the staff of the Bureau of Standards where he worked for two years on the properties of leather, with emphasis on military leathers. In 1948 he joined the Quartermaster Research and Development Division as head of the Leather Section; now he is chief of the Leather, Footwear and Handwear Branch of the Textile, Clothing & Footwear Division, Quartermaster Research and Development Command.

DR. JOSEPH NAGHSKI—See the April *Journal.*

DR. LUDWIG SELIGSBERGER, born and educated in Germany, worked both there and in Turkey before coming to the United States in 1937. After many years as chief chemist of the New Castle Specialty Division of Allied Kid Company in Wilmington, Delaware, he joined the Leather Technology

Laboratory Branch of the Quartermaster Research and Engineering Center, Natick, Mass., where he is now chief of the Synthetic Tanning Evaluation Section. He has published several papers in this *Journal*.

EDWARD T. STEINER, a graduate of George Washington University in organic chemistry, has had professional experience with the U. S. Department of Agriculture, Bureau of Standards, and Quartermaster Research and Engineering Command. Throughout most of his career he has specialized in tanning problems and has been author of numerous contributions to this *Journal* since 1942. For many years he has devoted much of his time to a study of leather stability in storage and leather specifications.

DR. WALLACE WINDUS—See last month's *Journal*.

One can cast up a rather formidable list of requirements of the engineer who directs development work in the forefront of technology. He should be:

a) Well-grounded in the analytical methods, the design techniques, and the conventional means of technical communication of the engineering fields involved. In other words, he should be an engineer.

b) Well-grounded in the related areas of science, both to understand the physical problems involved and to communicate effectively with the scientists whose work is basic to the development.

c) Well-informed regarding the available equipment, materials, fabrication techniques. The most advanced project will require conventional items such as motors, pumps, relays, amplifiers, instruments.

d) Open-minded about novel approaches to a problem but conservative about dependence on untested components and systems.

e) Knowledgeable about the technical and supporting staff required, the probable elapsed time, and the cost of comparable projects.

f) Capable of preparing and presenting reports on project plans and progress.

g) Capable of assessing the knowledge, ability, and progress of the engineers and scientists in the development "team".

h) Skilled in the appraisal of technical risk and related development time to avoid building an obsolete "klunker" on the one hand and, on the other, to avoid undertaking so many difficult problems at once as never to produce a prototype for test.

i) Ruthless in "freezing" the design when an acceptable means of achieving the objective is in sight—with some luck—and equally ruthless in abandoning a concept which turns out to be unsuitable.

j) Knowledgeable about existing technology. (Re-inventing the wheel is not a profitable exercise.)

—*Preparing Engineers for Advancing Areas of Technology*, the FIER Distinguished Lecture 1959, by Murrough P. O'Brien, Foundation for Instrumentation Education and Research, New York.

ALCA NEWS

Proceedings, Reports, Notices, and News

of the

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EMPLOYMENT NOTICE

POSITION WANTED—Man with technical training as tanner and finisher wants position in tannery or allied trades. Willing to relocate. Address Box L-73, c/o Secretary, American Leather Chemists Association, University of Cincinnati, Cincinnati 21, Ohio.

JALCA FILES FOR PAKISTAN LIBRARY

The library of the Leather and Footwear Center of Gurjranwala, West Pakistan, has recently received copies of *JALCA* dating back to 1934 thanks to the generosity of Dr. Albert E. Chouinard, head of the Department of Leather Technology at Lowell Technological Institute, Kenneth E. Bell, a director of LTI Research Foundation, and ALCA. The International Cooperation Administration provided funds to pack and ship the journals to the Center.

Instrumental in arranging this gesture of international good will was Mr. Bell, well-known leather consultant and member of our Association for over 25 years, who became acquainted with the Leather and Footwear Center and its principal, Dr. Gul Said Khan, in the course of a survey of the leather industry which he conducted in West Pakistan in 1957–58.

Mr. Bell describes the Center as a government institution for training men for the leather and footwear industries. Facilities are quite adequate, he says, with full-scale tanning equipment available as well as research and analytical laboratories. While many students take only vocational training, the advanced students are fully grounded in fundamental courses in chemistry as well as in the specialized phases of leather chemistry and technology.

COUNCIL MEETING MINUTES

October 8, 1959

Tanners Research Laboratory
Cincinnati, Ohio

The meeting was called to order by President Maeser at 9:30 A.M. Present were Messrs. Henrich, Retzsch, Somerville, Edmonds, Presley, Tetreault, Wederbrand, and O'Flaherty.

Minutes of the June 17 meeting were read by Dr. O'Flaherty. Council approved these minutes after the addition of E. Presley's name as councilor being in attendance.

Dr. Henrich, Chairman of the Technical Committee, advised Council of the committees from which he had received reports. He will prepare an annual report of all the committees' activities for the next meeting of Council.

Mr. Maeser read the Editor's report submitted by Dr. Windus. This was accepted by Council. Dr. Windus's letter also advised that the October *Journal* will be delayed due to labor difficulties at the printing firm.

Mr. Wederbrand, Ways and Means Chairman, advised that the Association is operating within the budget. He also presented the results of the 1959 Convention finances. An official annual report will be prepared for the January meeting.

Dr. O'Flaherty read the Convention Committee's report submitted by Dr. Stubbings. Council agreed that vegetable tannage should be the topic of the next symposium. Mr. Maeser will arrange to appoint a chairman of this symposium.

Sites for future conventions were discussed. Council approved a return to the Grand Hotel on Mackinac Island, June 17–20, 1962. Upon motion by Dr. Henrich, seconded by Mr. Tetreault, Council agreed that the Secretary should reserve June 16–19 at the Lido Hotel in Long Island for the 1963 annual meeting. Mr. Edmonds was asked to investigate the facilities available in Canada for the 1964 meeting and to report to Council at the January meeting.

Dr. O'Flaherty submitted a proposed scroll to be presented to the Honor Speaker for Council's consideration. Mr. Maeser advised that Mr. Meo had suggested another type of memento. Decision upon the scroll has been deferred until the next meeting.

Council was advised that the Honor Speaker for the 1960 meeting has not confirmed that he can attend. Upon motion by Dr. Somerville, seconded by Mr. Tetreault, Council agreed that if necessary, Mr. Maeser should, with Mr. Meo, select another Honor Speaker.

Purchase of a new slide projector was discussed. Mr. Wederbrand agreed to check with future convention hotels to see if they will furnish a slide projector. Council voted to hold the purchase of a new slide projector in abeyance until Mr. Wederbrand presents his report.

The prospective buyer for the public address system has not made a bid. Upon motion by Dr. Somerville, Council granted that until a purchaser is found, the system may be used by the University at the Secretary's discretion.

Mr. Maeser expressed his appreciation for being sent as an official delegate to the International Union of Leather Chemists Societies Meeting. He gave a brief summary of the procedure of this meeting. Mr. Maeser asked Council if the Association wishes to invite the International Union of Leather Chemists Societies to the United States for their 1961 meeting. Council discussed the possibility and then authorized the President to explore this matter and report at the next meeting.

The Secretary read a letter from an advertising agent requesting discount for advance payment of advertising. Council agreed to offer 5% discount for payment in advance of a full year.

Mr. Ernest Tschipper was elected to active membership.

Council approved a new style of badge which Dr. O'Flaherty exhibited.

The next meeting of Council will be held at the Plankinton House, Milwaukee, Wisconsin, the day preceding the Milwaukee Tanners Production Club's January meeting.

There being no further business, the meeting was adjourned at 11:30 A.M.

Respectfully submitted,

FRED O'FLAHERTY
Secretary

Much publicity has been given to the need for large numbers of scientists and engineers in an industrial society, to the fact that Russia is backing up its military and industrial program with an extensive program of scientific and technical education, and to the need for improving and expanding education for science and engineering in this country. Congressmen and public officials, educators, industrial leaders, and interested laymen have stressed this theme with results which have been generally beneficial—but included in these many statements there has been the expressed or implied conclusion that the *number* of engineers has been inadequate; more important, that our technological problems will be solved by increasing the *number* of engineering graduates. It is my contention that the *number* of engineers has been, and will continue to be, adequate and that our urgent need lies in another quarter. In particular, I will discuss the existing—and growing—deficiency in creative engineers and technical managers needed to carry out advanced development projects, both industrial and military. The need for *numbers* will continue to be met—and in fact plans already being implemented are likely to produce an over supply—but the deficiency I have in mind is not likely to be met effectively by present or proposed educational programs in engineering. Lip service is paid to the concept of education for the advanced areas of engineering but the implementation of these ideas falls short of what is needed to achieve the desired end. More science and mathematics in the engineering curricula, desirable as they are, will not ensure competence in development work on the part of the engineering graduates. Programs of study differing but little in content from those now in effect but drastically different in objectives and emphasis, are, I believe, desirable to this end.

—*Preparing Engineers for Advancing Areas of Technology*, the FIER Distinguished Lecture 1959, by Murrough P. O'Brien, Foundation for Instrumentation Education and Research, New York.

LETTERS TO THE EDITOR

Dr. R. G. Mitton of the British Leather Manufacturers Research Association, Egham, Surrey, England, has forwarded the following comments on Dr. Lollar's paper published in last June's JALCA. In so doing, Dr. Mitton wishes to make it clear that he is acting as an individual and not in his official capacity as chairman of two physical testing committees.

THE SIGNIFICANCE OF THE TENSILE TEST
SOME COMMENTS ON DR. LOLLAR'S PAPER

ABSTRACT

The author discusses certain points from Dr. Lollar's paper (*JALCA*, **54**, 306 [1959]) and concludes that:—

1. When drawing contour maps showing how leather properties vary with location in the hide or skin there is no justification for the procedure suggested by Dr. Lollar for deciding contour intervals.

2. The fact is well known that breaking loads are not accurately proportional to the areas of cross-section of the samples used for measurement. Dr. Lollar's statistical examination of data neither supports not refutes this, and gives no indication of the errors which arise if these quantities are taken as proportional to one another.

3. In certain circumstances, time and trouble are saved, and (as Dr. Lollar claims) there is no loss of accuracy, if breaking loads are used instead of tensile strengths. This is not a general conclusion, however, and in the example Dr. Lollar uses to discuss the point the comparisons are between samples of effectively the same cross-sectional area, so that breaking loads and tensile strengths are merely the same quantity measured in different units. His conclusion should not be regarded as having general validity.

In his interesting paper on the tensile strength test, Dr. Lollar makes a number of novel and stimulating suggestions, with many of which the present author would agree wholeheartedly. At the very least, they warrant serious discussion and consideration. It appears, however, that certain of his conclusions do not follow from the data he presents, and that his deductions are plainly wrong. Because of Dr. Lollar's well known standing in the leather industry, it appears to me important that these errors (as I regard them) should be criticised at once before they become the basis of further work and decisions. One of these errors was criticised in the discussion following presentation of his paper, and needs no further comment. The others are set out in what follows.

1. Contour maps, showing how physical properties depend upon the location in the hide or skin.

Referring to contour maps published by previous authors, Lollar says (page 320) "It is not clear what basis these authors used in the selection of the limits" (i.e. contour intervals) "for their contour maps; it seems probable

that rather arbitrary limits were set, which might have obscured the natural limits for the contour lines". Lollar evidently regards the point as important, for he devotes several pages to the re-presentation of data by Wilson according to a method which he regards as superior and less arbitrary. His procedure is as follows:—

(*a*) From the results at different locations on a hide or skin, calculate the spread of the results, expressing it as a standard deviation from the mean.

(*b*) Draw contour lines at intervals of one standard deviation.

I can see no justification whatever for this procedure. Insofar as the interval is set arbitrarily at one standard deviation instead of (say) one-half, one-quarter, or one-tenth of a standard deviation, the interval is no less arbitrarily chosen than any other. His interval is also too large to show any but the grossest details of the pattern. Finally, if Lollar's intention is to confine attention to details which can be regarded as statistically established, he has calculated a standard deviation which is largely irrelevant; it is large variability *from skin to skin* which makes it difficult to draw contour lines accurately, and not large differences within a skin.

Contour maps are a convenient method of presenting data in a graphical form which is easily apprehended and remembered. By statistical examination of the data on which a map is based, it might be possible to set limits to what features are to be presented, although it is doubtful whether the labour would be worth while. Lollar's method of linking contour intervals to the within-skins variability has, however, no justification, and will not, I hope, deter non-statistical workers from publishing contour maps for which they have adequate data.

2. The dependence of tensile strength upon the width and thickness of spehetcimens used for measurement.

It is well known that tensile strength measurements are not completely independent of the width and thickness of the specimens measured. This was established as long ago as 1932 by Sybin (*Collegium* 1932, 20), and confirmed by Kanagy, Mann and Mandel in recent work (*J.S.L.T.C.*, 1952, **36**, 231). The fact is, therefore, hardly in doubt. Lollar, however, attempts to demonstrate it by statistical arguments which require examination.

(i) He took 21 leathers from different sources and of different tannages, cut three neighbouring tensile specimens from each, and measured their breaking loads L and areas of cross-section A. He presents the following analysis of variance (of breaking loads), and points to the F ratio of 12.0 as evidence that the relationship between L and A is curvilinear. This is quite incorrect.

Source of Variation	Degrees of Freedom	Mean Square	F-Ratio
Ascribable to linear effect	1	61,067	
Ascribable to nonlinear effect	19	2,408	12.0
Between leathers	21—1=20	—	
Within leathers	21(3—1)=42	201	
Total	21×3—1=62	—	

It should be pointed out first that the mean square of 2,408 is *not* ascribable to some type of non-rectilinear regression, but measures what is not ascribable to rectilinear regression (a very different thing); it provides no information as to whether the deviations from rectilinear regression are due to curvature of the regression line or merely to random fluctuations about it. Second, the mean square 201 is a measure of the sampling variations of specimens from the same leather, so the F ratio of 12.0 indicates that these random variations are insufficient to account for the differences between the 21 leathers; in other words, it indicates that there are real differences between the strengths of the leathers, apart from mere sampling fluctuations. Since the leathers came from different sources and had different tannages, this is not surprising. The fact is that this analysis of variance has no bearing whatsoever on the question whether there is or is not a rectilinear relationship between L and A. The data could, of course, be analysed differently to see whether they provide any evidence of curvilinear regression, but it would be a waste of time to do so, since inspection of the graph where they are plotted (figure 11) reveals at once that there is none.

(ii) Referring to this graph he says: ". . . . this line" (a regression line) "does not pass through the origin, which, of course, is predictable, since the analysis of variance indicated that a straight line could not satisfactorily represent the data". Regression lines are, however, estimated statistically, and their positions and directions are subject to sampling fluctuations. It would, therefore, be an exceptionally lucky chance if his regression line happened to pass through the origin, and the relatively "near miss" he obtains provides no evidence that L is not accurately proportional to A; in the absence of other evidence it might well be held to support the reverse view.

(iii) Lollar further points out that the correlation coefficient between L and A is + 0.728 which "indicates that the interdependence of the two factors can account for only approximately one half of the variation in the tensile breaking load". This is quite irrelevant to his argument, because variations between leathers and random sampling fluctuations certainly account for much of the remainder, and their contribution is not estimated; as far as the argument is carried, these sources might well account for all of the remaining variation, leaving L accurately proportional to A. The same comment applies to Lollar's discussion on page 330 of Roddy and Jansing's data.

The following criticism can thus be made of this section of Lollar's paper:—

It is well known that breaking loads are not accurately proportional to the cross-sectional area of the leather specimens tested. Lollar's statistical examination of data neither supports nor refutes this, and gives no indication of the magnitudes of the errors which arise if the load is taken as accurately proportional to cross-sectional area. The latter point is important, because the paper, without actually saying so, gives the impression that the errors are considerable.

3. Roddy and Jansing's data, and the table on page 332.

This table shows coefficients of variation derived from Roddy and Jansing's data, and based on:

(a) breaking loads
(b) tensile strengths, or loads per unit area of cross-section.

Presumably, these coefficients of variation are estimates derived from means and residual error variances. The values of (*b*) are neither much smaller nor much larger than those based on (*a*), and Lollar therefore concludes that calculations based on tensile strength were a waste of time, and equally accurate results would have been obtained by using breaking loads instead. This conclusion appears perfectly sound. A conclusion which should *not* be drawn, however, is that in general circumstances breaking loads lead to values as accurate as those for tensile strength. Both give equal accuracy in Roddy and Jansing's experiments, but only because the experiments were designed in such a way that they would do so.

The specimens used by Roddy and Jansing were cut from side leather in relatively small blocks, and it is unlikely, therefore, that samples in any one block differed much in thickness. Since block-to-block differences are eliminated in finding the residual variance, all that Lollar's table on page 332 shows is that, *for the comparison of samples of the same thickness*, it is immaterial whether the breaking loads are divided by thickness or not. It might, of course, be quite another matter if the thicknesses of the specimens compared differed greatly.

Im most experiments where specimens of considerably different thicknesses are compared it is likely that tensile strength measurements will provide more accurate information than mere measurements of breaking load, although it should be recognised that this is not necessarily true of all experiments, even if specimen thicknesses differ considerably. (For example, if specimens deteriorate by a process that begins at the surface and works inwards, analysis of breaking loads might be the best procedure to adopt.) The point to be emphasised, however, is that the appropriate statistic (breaking load or tensile strength) will depend on the conditions of each experiment, and cannot be decided without knowledge of these conditions. Insofar as the example discussed by Lollar appears at first sight to be based on comparisons of specimens of different thicknesses, but in fact is not, it is liable to create an entirely false impression.

The central and characteristic activity [of engineering] is planning and design—synthesis plus analysis—with the synthesis of available knowledge and experience into an acceptable design as the essential element without which engineering would, I believe, lose its identity as a profession. Men who design circuits, structures, machines and processes, and systems of these elements, are acting as engineers, no matter how they acquired their proficiency; those who are not qualified for this type of work are at most "embryo" engineers, no matter what words may appear in their diplomas or their job descriptions.

There is reason to belabor at this time the nature of engineering and of the function performed by engineers because science and technology, scientists and engineers, have become an unresolved blur in the minds of educators, of industrial and governmental leaders, and of the general public. The problem goes far beyond semantics. Decisions regarding educational plans, financial support, faculty recruitment, and other important matters are affected by this situation—even to the point of confusing the engineering colleges themselves regarding their basic mission. It may seem trite and a little absurd to state that the primary objective of the engineering colleges should be to prepare their graduates to practice engineering—and, I would add, to practice it in the sense described above. Other objectives can, and should, be served but should be secondary in an engineering school.

—*Preparing Engineers for Advancing Areas of Technology*, the FIER Distinguished Lecture 1959, by Murrough P. O'Brien, Foundation for Instrumentation Education and Research, New York.

ABSTRACTS

Studies on the Formation of Mannich Linkages Involving Phenolic Compounds with Reference to the Interaction of Collagen with Certain Tanning Agents. S. M. Bose, and Y. Nayudamma. *Bull. Central Leather Research Inst., Madras*, **5**, 447–56 (1959).—The tanning action of resorcinol plus HCHO has been attributed to formation of C-type Mannich bases with the ε-amino N of collagen (see abstr. *JALCA*, **54**, 475 [1959]), but no such compounds involving resorcinol have hitherto been prepared. By working at low temperatures the authors succeeded in preparing compounds from resorcinol, HCHO, and various amino compounds (morpholine, piperidine) that had the empirical composition of the expected Mannich bases. Similar results were obtained with morpholine, HCHO, and either *bis* (resorcyl) methane or 3,7-dihydroxy-10-phenyl xanthene, both of which are tanning agents (*cf.* Tu and Lollar, *JALCA*, **50**, 324 [1950]) but not with 2,8-dihydroxy-5,0-diphenyl xanthene, which is not. The tanning action of the two compounds first named is enhanced by tanning in the presence of hexamethylene tetramine (HT), judging from rise in T_s, which is attributed to formation of Mannich-type bases with HCHO liberated from the HT. In tests with hide powder treated with *bis* (resorcyl) methane and HT, in which unused HT was determined in the combined filtrate and washings, it was found that about 10% of the HT was destroyed, while practically none of the HT was destroyed when hide powder was treated with HT alone. All this is taken as supporting evidence for the Mannich-base mechanism of tannage by resorcinol and HCHO. H.B.M.

Conservation of Heat Energy in the Leather Industry. R. Hock. *Leder Kurier*, **2**, 38–44, 65–67, 78–81, 97–110 (1958).—Standard formulae are given for calculating heat transfer through walls, roofs, pipes, etc. Calculations are given to show that savings in heat and coal of 95% or more can be attained by proper insulation of walls, steam pipes, etc. Thermal conductivities and other characteristics of various insulating materials are given. Thermal conductivity is discussed with respect to porosity and the influence of chemical composition, molecular constitution, temperature, moisture content, and cementing substances. Methods of measuring thermal conductivity and the types of insulation best suited for various purposes are discussed. I.D.C.

Supplement to *Recent Developments in the Field of Leather Oiling*. E. Quendt. *Das Leder*, **10**, 57 (1959).—See *JALCA*, **54**, 368. I.D.C.

Preparation of Chromium (III) tris (β aminoethylate). A. Küntzel and H. Trabitzsch. *Das Leder*, **10**, 102–26 (1959).—Chromic salts react with 3 mols. of monoethanolamine in the absence of water to form deep-blue complex compounds having the formula $[Cr(C_2H_6ON)_2(C_2H_7ON)]$ Cl. If green chromium sulfate (basicity about 20%) is dissolved in an equal weight of water and the solution is added slowly to an excess of monoethanolamine (about 15 moles per gram atom of the sulfate), a dark green precipitate forms that dissolves at 130°; on cooling, red needle clusters crystallize out.

Only the beta form of $Cr(OH)_3$, in which 2 Cr atoms are joined by 2 OH groups, react with ethanolamine to form the red complex. When alcoholic $CrCl_3$ or $Cr(NO_3)_3$ are treated with NaOH or NH_3, the beta form of hydroxide is always formed and will react with ethanolamine. Only freshly precipitated hydroxide will react; if it is filtered and washed for purification, the red complex does not form. Partial purification is possible by washing the red crystals with monoethanolamine until free from ethanolamine salts, then washing with alcohol. On recrystallization from a small amount of water, hexagonal instead of needle-like crystals form. An empirical formula reaction with chromium chloride is as follows:

$$CrCl_3 + 6HOCH_2CH_2NH_2 = Cr(OCH_2CH_2NH_2)_3 + 3\ HOCH_2CH_2NH_3Cl$$

I.D.C.

Newer Knowledge in the Field of Leather Drying. H. Leistner. *Leder Kurier*, **2**, 27–33, 44 (1958).—Leather drying occurs in two stages. The first stage, in which capillary water is removed, is independent of tannage but depends on temperature, moisture difference between leather and air, and air velocity. A drying study was made with 18 x 24 cm. photographic plates. Air tended to follow the path of least resistance and to separate from the plates, so that a change in direction of the air across the plates was very important. For quality drying, air must be fed uniformly over the whole area and be drawn off the same way. The ventilator fan should move air over a heater, then into a pressure vessel to remove turbulance and to give an even flow through the slits into the drying chamber. The chamber should be divided into several zones with a change in air flow direction from zone to zone. Uniform drying prevents overdrying of the leather surface. Rapid drying of the surface makes it horny and so prevents diffusion of water from the interior of the leather. Humidity must drop uniformly through the dryer; otherwise there may be absorption rather than loss of water in some zone. A graph is given which shows water content of leather (8–25%) at various temperatures (10°–70°), and relative humidities (20–95%). Paste-drying on glass or metal plates and drying of heavy leather are described. I.D.C.

Changes in Hide Quality on Long Storage in Salt. P. Kontio, O. Lokki, and A. Ristola. *Das Leder*, **10**, 126–29 (1959).—A storage test was made to determine whether the state of preservation of a large pack of salted hides could be reliably estimated from a chemical analysis of a few specimens. From a pack containing 1486 pieces of 4–12 kilogram skins, 15 of average weight were selected and stored between other hides in a hide cellar at 9°–11°C. Analytical samples were taken from each skin after 3, 8, and 14 months storage. A composite sample representing all 15 skins was also prepared. All samples were ground in a sausage cutter. Three sample locations were chosen, one in the shanks and one from each side of the backbone in the bend area. Determinations were made of moisture, salt, total nitrogen, water-soluble matter, and volatile nitrogen (NH_3). Volatile nitrogen in skins stored for 8 months was 3 times that in skins stored for 3 months, but there was little difference in extractable nitrogen. Skins stored for 14 months contained about twice as much extractable nitrogen but only slightly more volatile nitrogen than those stored for 8 months. A statistical analysis was made of the analytical data. The greatest source of variation was time of storage. Volatile nitrogen

showed some variation between skins, but little between locations. There was good agreement between analytical values for shank versus bend locations and between right versus left side of the backbone. Determination of volatile nitrogen in an aqueous extract of a hide sample was a suitable method for assessing the state of preservation of the hide. Shank pieces were as good as those from the bend. Analysis of a composite sample gave sufficiently accurate results. The difference between results for a composite sample and the average of results from analyses of the individual skins was within experimental error of the method. I.D.C.

A New Method for Investigating the Sludge in Vegetable Tan Liquors. A. Lenart and G. Vagó. *Das Leder*, **10**, 129–33 (1959).—Instead of the usual method of weighing the amount of sludge formed at different concentrations of tannin extract, measurements were made of the decrease in volume of sludge in a tan liquor of constant concentration caused by addition of increasing amounts of syntan. Dispersing action of the syntans was also determined by measuring light transmission of the tannin-syntan mixture just after shaking (L_t), and of the clear, supernatant liquid after settling (L_k). L_t/L_k is the turbidity value. Although addition of syntan diluted the extract, this effect could be neglected in these tests where dispersion occurred with 5–15% of syntan. The type of sludge was noted, and readings were made of (1) volume of heavy, rapid-settling sludge, (2) volume of suspended sludge that settled very slowy, and (3) turbidity. The experimental procedure was as follows: The tannin extract was allowed to swell in water overnight, boiled until dissolved, and diluted to 5°Bé with water continuing 1 g. $CaCl_2$ per liter (hardness 50°). At the same time a 9% solution (about 5°Bé) of the syntan was prepared. Mixtures (110 ml. each) of the tannin extract solution and syntan were prepared to contain 0, 3, 5, 10, 15, 20, 30, and 40% of syntan. The mixtures were heated for a short time, then shaken for 1 hour, after which 10 ml. was removed at once, diluted to 40 ml., and used for measurement of transmission L_t. The remaining 100 ml. of each mixture was put in a series of 100-ml. graduated cylinders of the same height and width and left overnight at 20° ±2°C. to settle. Readings were then taken of the volumes of (1) clear liquid, (2) flocculant sludge, and (3) firm sludge. Also 10 ml. of the clear liquid was diluted to 40 ml. and used for measurement of L_k. Reproducible results were obtained by this method. Numerous dispersing agents and syntans were investigated. The optimum amounts of Basyntan extra J, Tanigan extra KN, and Syntanol OPA for dispersion of sludge in various extracts were as follows: sweetened chestnut 5, 10, and 20% resp.; valex 10, 10, and 30%; wattle 5, 5, and 5%; and oak 20, 30, and 30%. In addition to these three syntans, good results were found with Tanigan extra B, Rotanin W (sulfonated novolak), Kortan KN (naphtholsulfo acid–phenol condensate) and Basyntan C. White leather syntans did not cause enough dispersion. Urea-formaldehyde condensates reacted with vegetable tannins to form more sludge. The above method is a rapid procedure for determining the minimum amount of dispersing agent for optimum sludge prevention. I.D.C.

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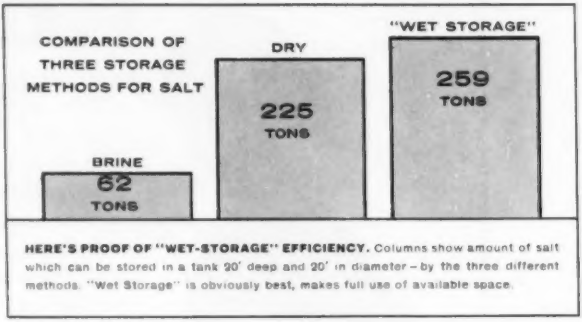

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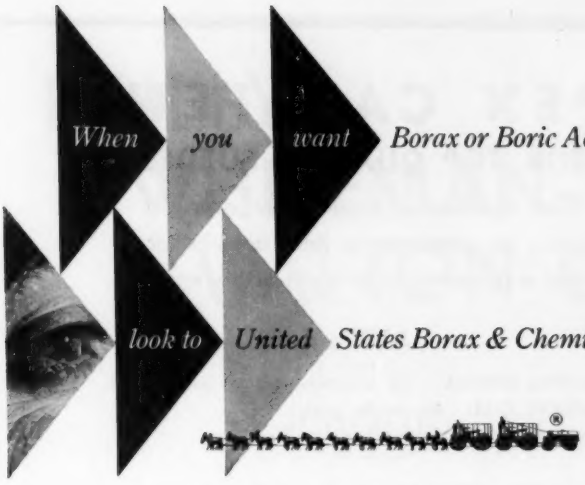

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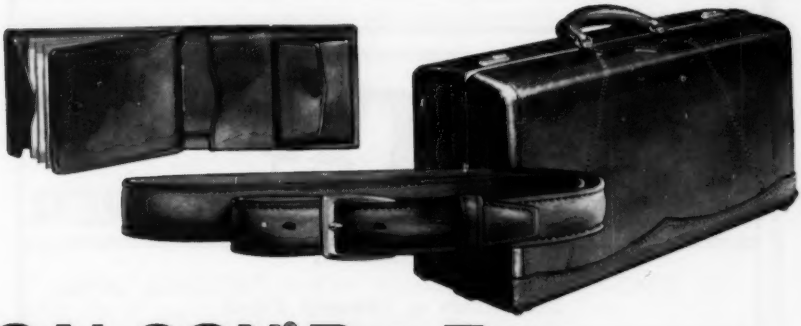

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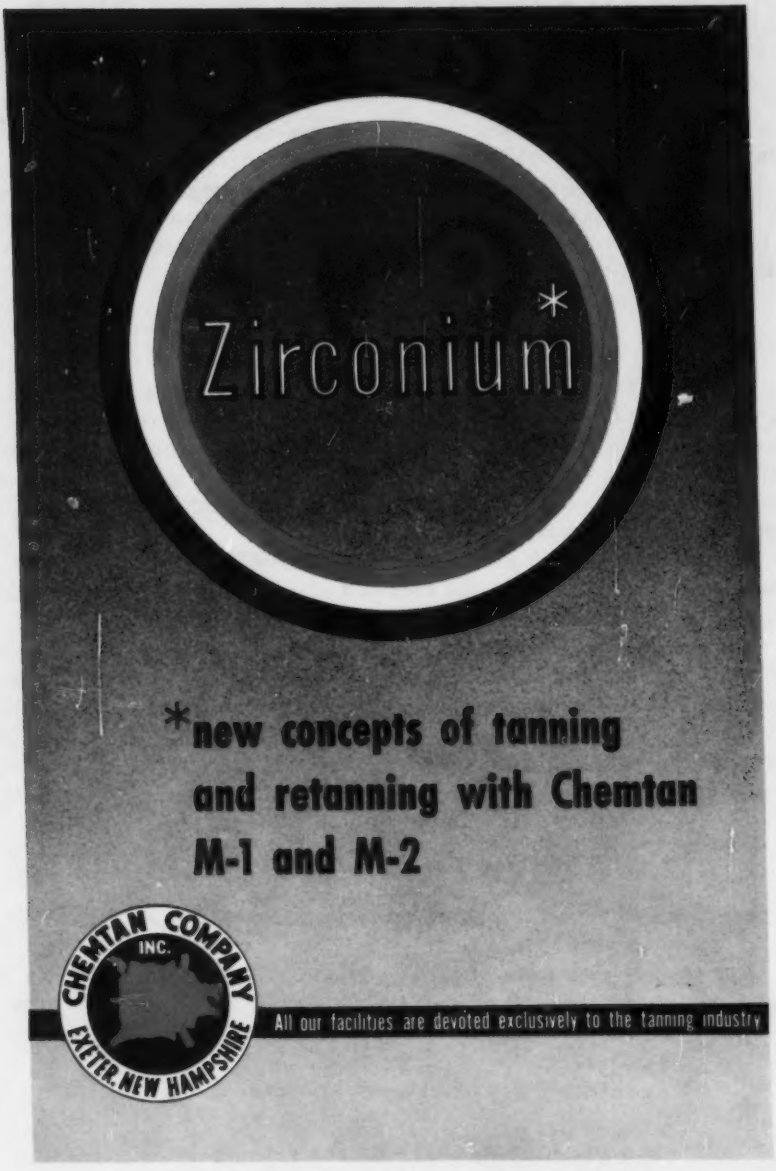
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